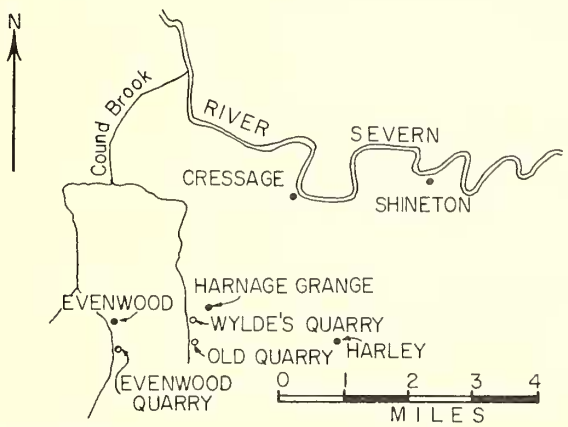
TREPOSTOME BRYOZOA FROM THE CARADOC SERIES, SHROPSHIRE

by JUNE R. P. PHILLIPS ROSS

ABSTRACT. *Mesotrypa bulmani* sp. nov., *Amplexopora thomasi* sp. nov., *Homotrypa* sp. A, and *Homotrypa* sp. B occur in the Hoar Edge Limestone in the lower part of the Caradoc Series, near Evenwood and Harnage. These trepostome species show similarities with species from Cincinnatian strata in Ohio, Indiana, and Anticosti Island.

THE four trepostome species described in this paper were collected from the lower part of the Caradoc Series in the Evenwood and Harnage area in southern Shropshire (text-fig. 1). *Mesotrypa bulmani* sp. nov., *Amplexopora thomasi* sp. nov., and *Homotrypa* sp. A occur in the *Harknessella subquadrata* horizon in the section at Evenwood Quarry (text-fig. 2). *Mesotrypa bulmani* is also found in two quarries in the Hoar Edge Limestone south-west of Harnage Grange, and *M. bulmani* sp. nov., *A. thomasi* sp. nov., and *Homotrypa* sp. B occur in this formation at the Wilderness, Wilstone Farm House. These species are from fossil collections made during the mapping of the Shrewsbury District and locality data and identifications made by Dr. C. J. Stubblefield and Dr. G. Elles are listed in Pocock *et al.* (1938). The cryptostome *Phaenopora stubblefieldi* Ross (1962) from the Hoar Edge Limestone also came from these collections and was located in the upper part of the 15-foot section in Evenwood Quarry in the *Harknessella subquadrata* horizon which overlies lower units containing graptolites of the *Nemagraptus gracilis* Zone. The succeeding sandstone and shale beds above the Hoar Edge Limestone contain graptolites regarded as characterizing the *Diplograptus multidens* Zone.



TEXT-FIG. 1. Index map of Evenwood–Harnage area, Shropshire.

Few bryozoan species have been described from the Caradoc Series and the occurrence of species of *Amplexopora*, *Homotrypa*, and *Mesotrypa* which have been recorded from

[Palaeontology, Vol. 6, Part 1, 1963, pp. 1–11, pl. 1–3.]

Ordovician strata in North America, Greenland, England, Estonia, Russia, and Australia, adds to the knowledge of the distribution of these three genera. *Mesotrypa bulmani* sp. nov. is similar to *M. orbiculata* from the Cincinnatian Arnheim Formation of south-eastern Indiana, *M. patella* from the Whitewater Formation of south-western Ohio (text-fig. 3), and *M. infida* from the *Rhinidictya* beds in Minnesota. It shows little similarity to *M. leus* (M'Coy) (Spjeldnæs 1957) from the Caradocian Horderly Sandstone of eastern Shropshire.

Amplexopora thomasi sp. nov. resembles *A. pustulosa* from the Cincinnatian Waynesville Shale of south-western Ohio, *A. ampla* from the Cincinnatian Leipers Limestone of central Tennessee and the Cincinnatian Fairmount Member of south-western Ohio, and *A. billingsi* from the Cincinnatian English Head and Vaureal Formations of Anticosti Island.

Homotrypa sp. A is similar to a rare species, *H. dumosa*, from the Cincinnatian Fairmount Member of south-western Ohio, and *Homotrypa* sp. B has many morphologic features that resemble *H. obliqua* from the Cincinnatian Fairmount and Corryville Members of south-western Ohio, and *H. wortheni* from the Cincinnatian Whitewater Formation of south-western Ohio and south-eastern Indiana.

Collection numbers with the prefixes WM and RR, and specimen numbers with the prefix GSM refer to material in the Geological Survey Museum, London.

SYSTEMATIC DESCRIPTIONS

Family AMPLEXOPORIDAE Miller 1889
Genus AMPLEXOPORA Ulrich

1882 *Amplexopora* Ulrich, p. 154.
1960 *Amplexopora* Ulrich; Boardman, pp. 16–20.
1920 *Acanthotrypella* Vinassa de Regny, p. 221.

Type species. *Amplexopora cingulata* Ulrich (1882, pp. 126, 254–6, pl. 11, figs. 5, 5*a–c*); designated by Ulrich (1882, p. 255).

Diagnosis. Colonies are ramose, encrusting, massive, or rarely bilaminate. Monticules are commonly present. Zooecial openings are polygonal and are enclosed by generally integrate zooecial walls. Mesopores are generally not abundant. Acanthopores are commonly abundant and occur at the junctions of zooecial walls. In axial regions the zooecial tubes have slender walls. In the peripheral regions the thickened zooecial walls have a laminate microstructure in which the outer parts of adjacent zooecial walls have steeply inclined laminae that intersect at acute angles. Diaphragms are present in the peripheral and subperipheral regions and may be flat, curved, or cystoidal. Some species display cystiphragms.

Amplexopora thomasi sp. nov.

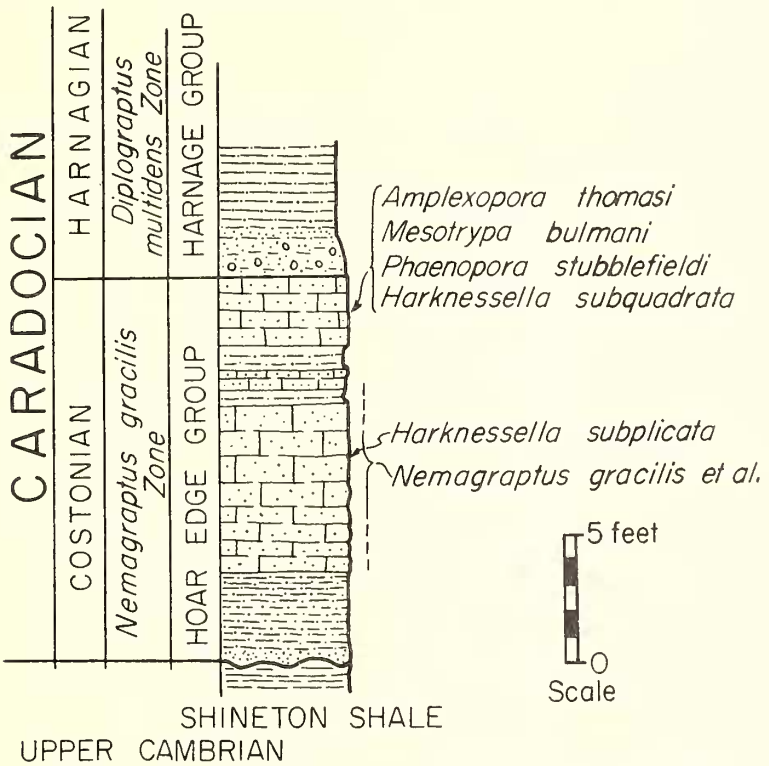
Plate 1, figs. 1–10

Material. Collections WM 1265 (including paratype GSM 102009), WM 1267, WM 1273 (including holotype GSM 102004, paratypes GSM 102005, GSM 102006), WM 1274 (including paratype GSM 102007), from the top part of Evenwood Quarry; and collection WM 1279, from the middle part of Evenwood Quarry; Hoar Edge Limestone, Hoar Edge Group; Caradoc Series; Ordovician.

Description. In tangential sections the slender, integrate zooecial walls enclose polygonal

or subpolygonal zooecial openings which vary considerably in diameter (Pl. 1, figs. 1, 7, 10). One to two mesopores are generally located at the junctions of the zooecial walls (Pl. 1, figs. 1, 10). Acanthopores are rare and, if present, are small, dense spots in the zooecial walls.

Transverse sections of ramose colonies display axial regions with thin-walled polygonal zooecial tubes and peripheral regions with thickened, integrate zooecial walls and



TEXT-FIG. 2. Measured section of the Hoar Edge Group in Evenwood Quarry (after Pocock *et al.* 1938).

diaphragms crossing the zooecial tubes. Transverse sections of bilaminate colonies display a dark medial line lacking microstructure and with zooecia on both sides of it. The zooecial tubes have thin walls in the medial region and thickened, integrate walls and diaphragms in the peripheral region (Pl. 1, figs. 2, 4).

In longitudinal sections of ramose colonies the axial regions display very broadly crenulate zooecial walls that are very slender. For some distance the walls diverge only slightly from the axis of growth of the branch and then bend abruptly into the peripheral region. In this region they thicken and are more closely crenulate and very slightly beaded. The zooecial openings are slightly oblique at the periphery. The zooecial and mesospore walls have an integrate, laminate microstructure as noted in the *Diagnosis* of *Amplexopora* (Pl. 1, fig. 9). The very slender, widely spaced diaphragms crossing the zooecial tubes pass into the steeply inclined wall laminae (Pl. 1, fig. 9). In the mesopores, which develop at the base of the peripheral region, the diaphragms are closely spaced.

In longitudinal sections of bilaminate colonies the zooecial tubes curve gently to the periphery and are crossed by widely spaced diaphragms. The zooecial openings are oblique to the periphery (Pl. 1, fig. 8).

TABLE 1

Measurements of *Amplexopora thomasi* sp. nov. (in millimetres)

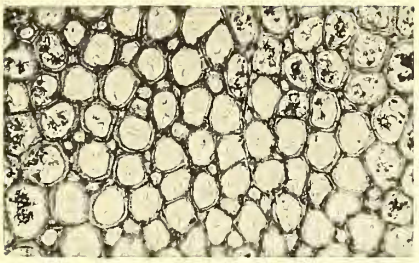
Catalogue no.		*GSM 102007*	*GSM 102004 holotype*
Diameter of zoarial stem		6–7	6–7
Diameter of zooecial opening	min.	0·14×0·16	0·15×0·15
	max.	0·31×0·22	0·23×0·21
No. of zooecia per 2 mm.		6–8	6–8
Combined thickness of adjacent zooecial walls in peripheral region		0·04–0·06	0·04–0·06
Diameter of mesopore	min.	0·03×0·03	0·05
	max.	0·10×0·12	0·10
Diameter of acanthopore		0·01–0·04	0·01–0·02
No. of acanthopores per zooecium		0–6	0–5
No. of diaphragms per 1 mm. in zooecium in peripheral region		4–6	3–5
No. of diaphragms per 1 mm. in mesopores		14–20	11–15
Width of peripheral region		1·2	2·0
Ratio: width of peripheral region of zooecium/total width of zooecium		0·4	0·6

Remarks. The species is characterized by slender zoarial stems with wide peripheral regions in which the thickened, crenulate, and slightly beaded zooecial and mesopore walls are distinctly integrate and in which mesopores have closely spaced diaphragms and the zooecial tubes have widely spaced diaphragms. Acanthopores, if present, are not prominent.

Amplexopora thomasi is similar to *A. billingsi* (Bassler 1928) from the Ordovician (Cincinnatian) English Head and Vaureal Formations, Anticosti Island. *A. billingsi* has

EXPLANATION OF PLATE 1

Figs. 1–10. *Amplexopora thomasi* sp. nov. 1, Tangential section showing integrate walls between zooecial tubes and mesopores, collection WM 1273, holotype GSM 102004, ×20. 2, Transverse section of a bilaminate colony showing narrow peripheral region of thickened walls, collection WM 1273, GSM 102005, ×20. 3, Part of longitudinal section in peripheral region showing thick, laminate zooecial walls and diaphragms in zooecial tubes and mesopores, collection WM 1274, GSM 102007, ×50. 4, Part of transverse section of bilaminate colony showing integrate, laminate zooecial walls in peripheral region, collection WM 1273, GSM 102005, ×50. 5, Part of a longitudinal section in the peripheral part of a ramose colony showing the finely crenulate zooecial walls, collection WM 1273, GSM 102004, ×20. 6, Part of a longitudinal section of a ramose colony showing very slender walls in the axial region and thickened walls in the peripheral region, collection WM 1274, GSM 102007, ×20. 7, Tangential section showing general arrangement of zooecial openings, collection WM 1274, GSM 102007, ×20. 8, Longitudinal section of a bilaminate colony showing diaphragms across zooecial tubes, collection WM 1265, GSM 102009, ×50. 9, Part of a longitudinal section in peripheral part of a colony showing integrate, laminate zooecial walls, and thin diaphragms, collection WM 1274, GSM 102007, ×100. 10, Tangential section showing distinct boundaries between adjacent zooecial walls, collection WM 1273, GSM 102004, ×50.



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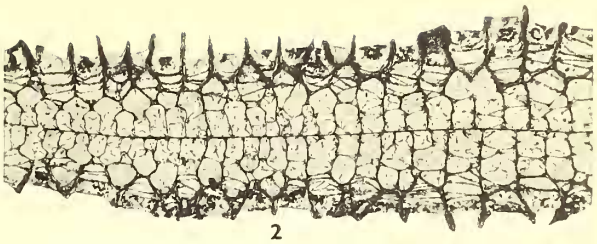

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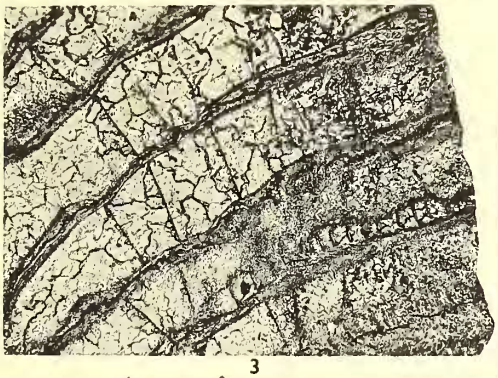

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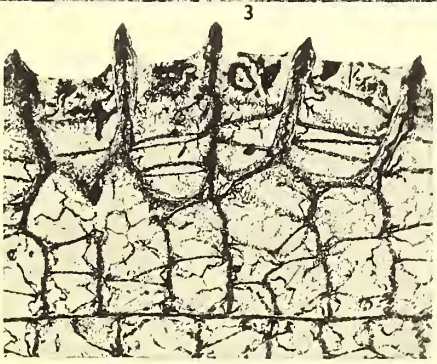

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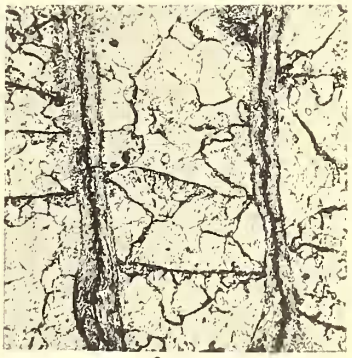

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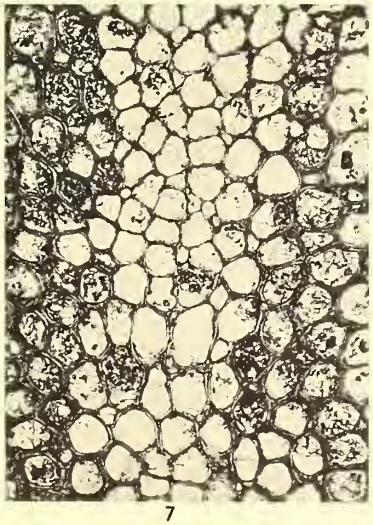

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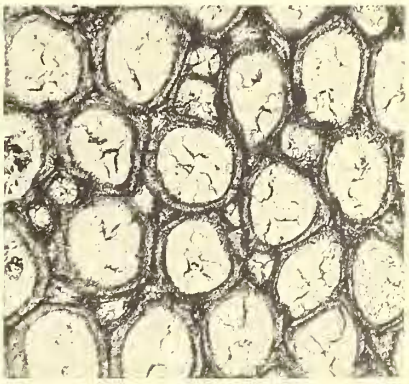

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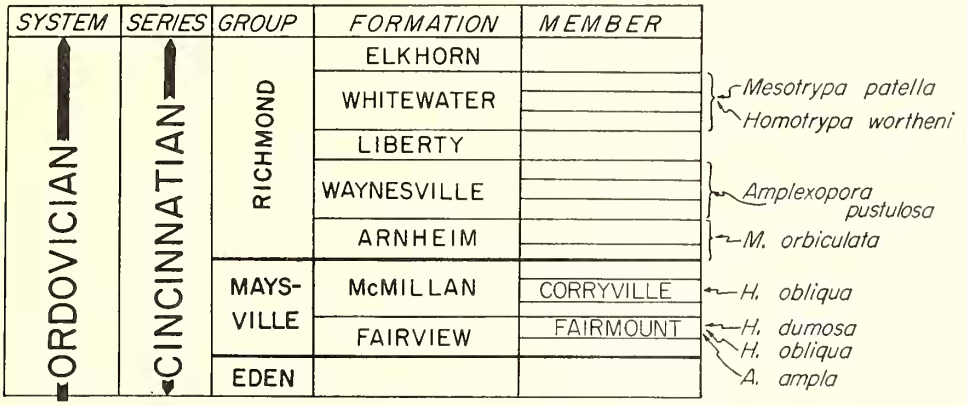
PHILLIPS ROSS, Ordovician Bryozoa

fewer zooecial openings per 2 mm., fewer mesopores, and more numerous diaphragms in the zooecial tubes. Both species have inconspicuous acanthopores, closely spaced diaphragms in the mesopores, and crenulate zooecial walls. *A. thomasi*, *A. pustulosa* Ulrich (1890) from the Ordovician (Cincinnatian) Waynesville Shale, Hanover, Ohio, and *A. ampla* Bassler (1904) from the Ordovician (Cincinnatian) Leipers Limestone, Nashville, Tennessee, are similar in the diameter of their zoarial stems and have about the same number of zooecia per 2 mm. *A. pustulosa* and *A. ampla* differ from *A. thomasi* in having diaphragms in the axial region, and *A. pustulosa* commonly has acanthopores at the junctions of the zooecial walls and has few mesopores in the peripheral region.



TEXT-FIG. 3. General geologic column of formations and members in the Cincinnatian Series in south-western Ohio and south-eastern Indiana from which Bassler (1915) reported the bryozoan species that are here compared with the Caradocian species.

Amplexopora thomasi appears to have some similarity to *A. wurchisoni* (Spjeldnæs 1957), the type of which is from 'Horderley', Shropshire, but its exact locality and stratigraphic position is not known. Unfortunately the type material of *A. murchisoni* is partly recrystallized so that recognition of the species is difficult. However, Spjeldnæs (1957, text-figs. 1*a*, *b*) illustrates the typical wall microstructure of species of *Amplexopora* and his text-fig. 1*b* appears to show small mesopores and also acanthopores at the junctions of the zooecial walls.

The species is named in honour of Dr. H. Dighton Thomas, British Museum (Natural History).

Family MONTICULIPORIDAE Nicholson
Genus MESOTRYPA Ulrich 1893

Type species. Mesotrypa infida (Ulrich 1886, p. 88).

Diagnosis. Colonies are discoidal, hemispherical, conical, or encrusting expanses. Lower surfaces of discoidal colonies are flat or concave. Polygonal or cylindrical zooecial tubes grow directly upwards from the basal lamina and are crossed by flat and curved diaphragms. Mesopores are present in both the proximal and distal parts of a colony and have closely spaced diaphragms. Zooecial openings are polygonal in some colonies and circular in others. Mesopore openings are rectangular or polygonal and may be very

small. Acanthopores are prominent where the zooecial openings are angular and mesopores are small, and they are small and indistinct in colonies where zooecial openings are round and mesopores are large. The zooecial and mesopore walls display a granular microstructure at low magnifications.

Mesotrypa bulmani sp. nov.

Plate 2, figs. 1–9; Plate 3, figs. 2, 4

Material. Collections WM 1262 (including paratype GSM 102003) and WM 1274 (including paratype GSM 102008), from the top part of Evenwood Quarry. Collection WM 1279 (including paratypes GSM 102011–102015), from the middle part of Evenwood Quarry. Collections RR 2635 (including paratype GSM 102016), RR 2636 (including paratype GSM 102019), RR 2637, and RR 2638, from the old quarry in the wood near Coundmoor Brook. Collections RR 2669 and RR 2672 (including holotype GSM 102017), Wylde's Quarry, near Harnage Grange. All collections from Hoar Edge Limestone, Hoar Edge Group; Caradoc Series; Ordovician.

Description. Many of the discoidal colonies, 10 to 13 mm. diameter at their bases, and 1 to 2 mm. high, have flat or concave bases. The encrusting colonies vary from small, cylindrical forms, 1·5 to 2 mm. in diameter, to broad, explanate forms that extend across fragmented shells and other material.

In tangential sections the zooecia are variable in size and shape. In a well-developed discoidal colony, GSM 102017, almost round zooecial openings and polygonal or rectangular mesopores fill the spaces between clusters of large, polygonal zooecial openings and a few mesopores. In these clusters where the mesopores are very few, acanthopores, 0·02 to 0·03 mm. in diameter, are present at the junctions of the zooecial walls (Pl. 2, fig. 7); where the mesopores are distinctly visible between the zooecia, the acanthopores are generally lacking (Pl. 3, fig. 4). In an encrusting form, GSM 102003, and a discoidal form, GSM 102015, the polygonal zooecial openings are separated by a few mesopores, and prominent acanthopores, 0·03 to 0·06 mm. in diameter, lie at the junctions of the zooecial walls (Pl. 2, fig. 8). Deeper tangential sections of colonies display more slender walls enclosing polygonal tubes (Pl. 2, fig. 5). Walls between zooecia and mesopores are slender and amalgamate.

In longitudinal sections the zooecial tubes may be slightly reclined for a short distance along the basal lamina (Pl. 2, fig. 4). Acanthopores and mesopores are commonly present a short distance above the basal lamina and extend to the distal parts of colonies.

EXPLANATION OF PLATE 2

Figs. 1–9. *Mesotrypa bulmani* sp. nov. 1, Part of longitudinal section of subperipheral and peripheral parts of colony showing diaphragms in the zooecial tubes and mesopores, collection WM 1279, GSM 102011, × 50. 2, General aspect of transverse section, collection WM 1279, GSM 102012, × 20. 3, Part of a longitudinal section of a multilaminate colony showing thin, granular walls in the peripheral region, collection RR 2635, GSM 102016, × 50. 4, Longitudinal section of multilaminate colony showing slender zooecial walls and diaphragms in the zooecial tubes and mesopores, collection WM 1279, GSM 102013, × 20. 5, Deep tangential section showing distinct acanthopores at the junctions of very slender zooecial walls, collection WM 1274, GSM 102008, × 50. 6, Tangential section showing polygonal zooecial openings, numerous mesopores, and very fine acanthopores, collection RR 2636, GSM 102019, × 50. 7, 8, Tangential sections showing distinct acanthopores at junctions of zooecial walls; collection RR 2672, holotype GSM 102017, × 50; and collection WM 1262, GSM 102003, × 50, respectively. 9, Oblique longitudinal section showing diaphragms in the mesopores and in the long zooecial tubes, collection WM 1279, GSM 102011, × 20.

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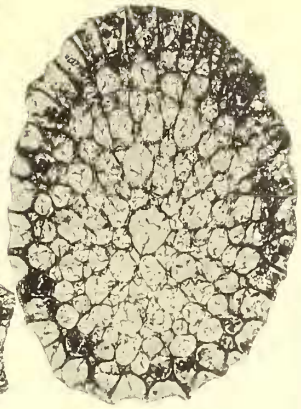

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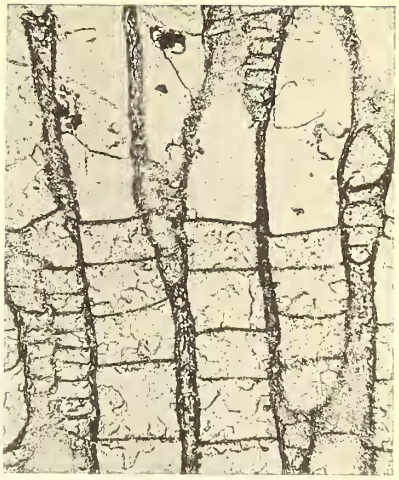

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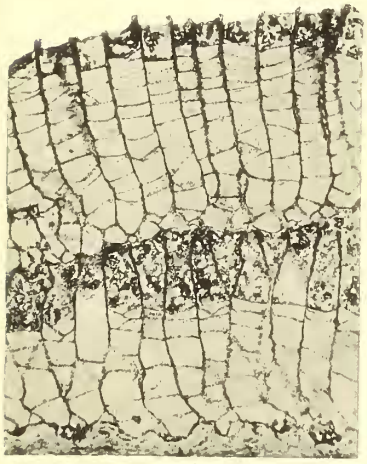

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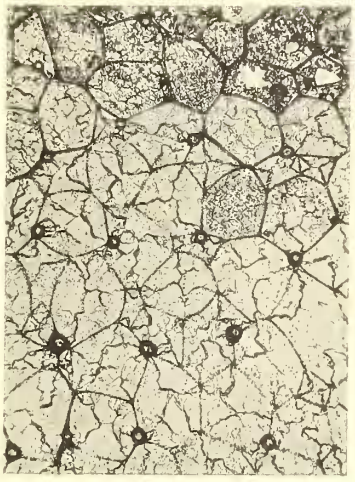

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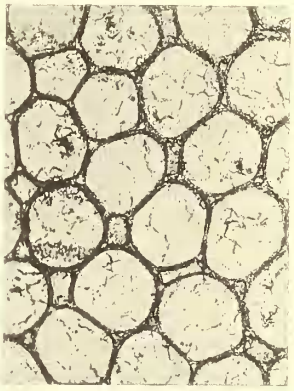

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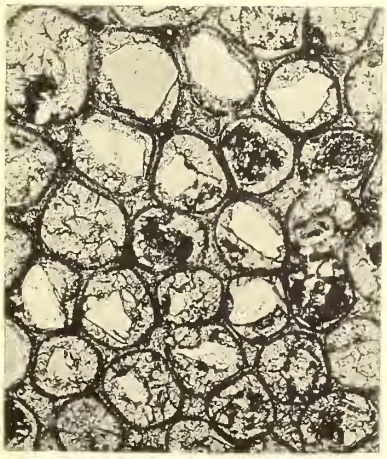

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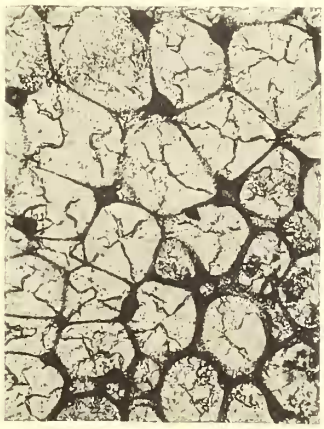

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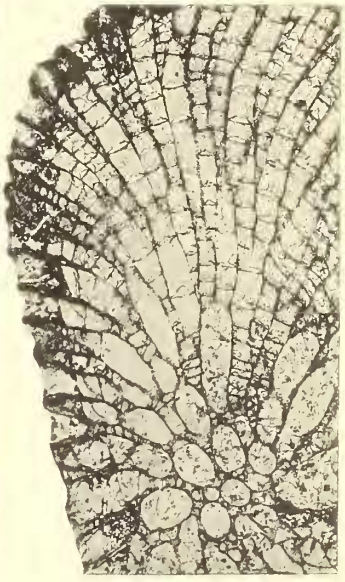

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As the walls, mesopores, zooecial tubes, and acanthopores have some variation in their direction of growth, a longitudinal section may pass across and then back into a mesopore, acanthopore, or even a zooecial tube. The zooecial and mesopore walls thicken slightly as they extend to the periphery (Pl. 2, figs. 4, 9). The very slender zooecial walls have a very fine, laminate microstructure that commonly appears granular at low magnifications. The clear inner parts of the zooecial walls lining the zooecial tubes consist of fine laminae lying at 45 degrees to the inner boundary. The outer parts of adjacent zooecial walls appear as dark bands of intertonguing convexly curved, granular

TABLE 2

Measurements of *Mesotrypa bulmani* sp. nov. (in millimetres)

Catalogue no.		*GSM 102017*
No. of zooecia per 2 mm.		8–10
Diameter of zooecial opening	max.	0·22×0·22
	min.	0·16×0·16
Diameter of zooecial opening in monticule	max.	0·29×0·29
	min.	0·29×0·26
Combined thickness of adjacent zooecial walls in peripheral region		0·02
Diameter of mesopore	max.	0·10×0·15
	min.	0·06×0·03
Diameter of acanthopore		0·01–0·03
No. of acanthopores per zooecium		2–4 in monticules
No. of diaphragms per 1 mm. in zooecium		6–8
No. of diaphragms per 1 mm. in mesopore		about 25

laminae. The thin diaphragms crossing the zooecial tubes and mesopores pass into the wall laminae after bending abruptly at the zooecial wall boundary. Acanthopores have slender, dark walls enclosing clear axial spaces. In encrusting forms the zooecia extend upright to the periphery and in discoidal forms the zooecial tubes curve broadly near the periphery (Pl. 2, figs. 4, 9). Diaphragms are present throughout the length of the zooecial tubes and are commonly flat, or convexly or concavely curved, and in the peripheral region may be more closely spaced and include additional kinds such as compound and cystoidal diaphragms (Pl. 2, fig. 4). The mesopores have closely spaced diaphragms throughout their length (Pl. 2, figs. 3, 4, 9).

Remarks. The species is characterized by small, commonly discoidal colonies with round or subpolygonal zooecial openings, sparsely distributed mesopores, abundant diaphragms throughout the length of the mesopores, widely spaced diaphragms in the zooecial tubes, and small acanthopores which are most prominent in the monticules.

Mesotrypa bulmani is similar to *M. infida* (Ulrich 1886, 1893) from 'the middle third of the Trenton Shales at Minneapolis' (= the *Rhinidictya* and *Ctenodonta* beds of Ulrich 1893, p. *l*) in the form of the zoarium and the shape of the zooecial openings. *M. bulmani* has smaller zooecial openings both in and between the monticules, has fewer acanthopores per zooecium, and lacks funnel-shaped diaphragms. *M. bulmani* resembles *M. orbiculata* Cumings and Galloway (1913) from the Ordovician (Cincinnatian) Arnheim Formation near Harmon's Station, Indiana, in the size and form of the colonies,